POWERCORP

Intelligent Power Systems

WIND/DIESEL WORKSHOP

Emerging Markets/Pilot Projects

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AGENDA

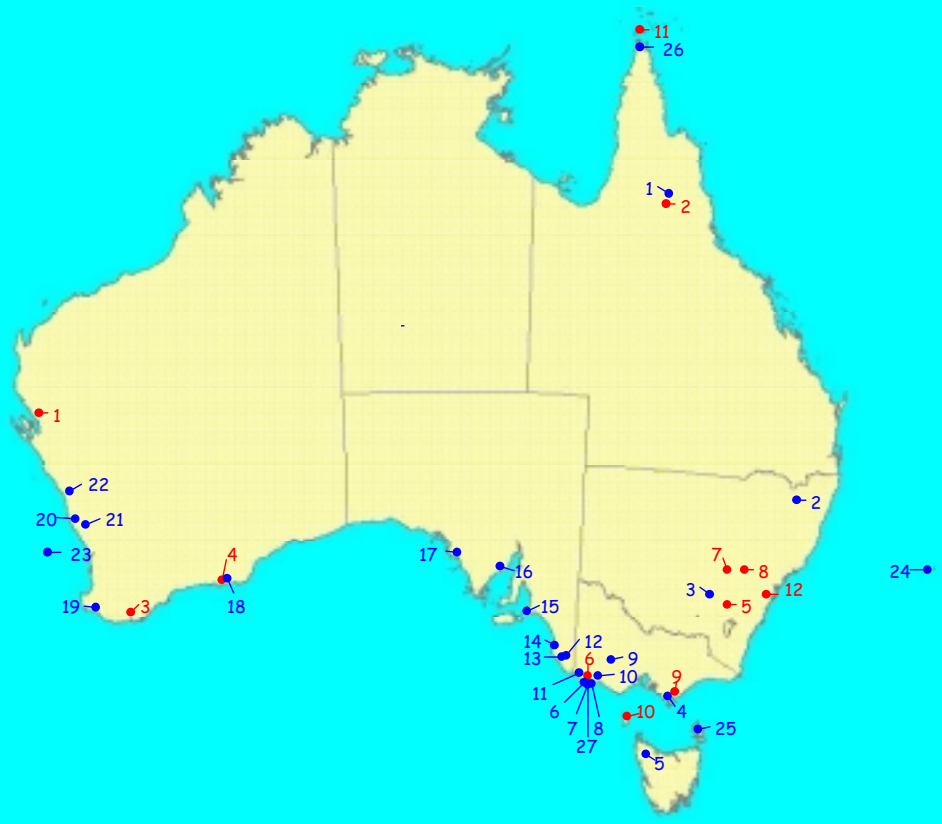
1. Wind/Diesel – The Australian Market
2. Esperance 14MW Wind/Gas System
3. Mawson High Penetration No Storage

The Australian Wind Energy Market

WIND FARM OPPORTUNITIES IN AUSTRALIA – MAY 2002

Existing	Owner	WTG Mfr	MW
1. Denham	WPC	Enercon	0.7
2. Windy Hill	Stanwell	Enercon	12
3. Albany	WPC	Enercon	21.6
4. Esperance	ADI	Vestas	2
5. Crookwell	Pacific Power	Vestas	4.5
6. Codrington	Pacific Hydro	Bonus	18
7. Blaney	Pacific Power	Vestas	9.9
8. Hampton	Hickory Hill	?	1.2
9. Toora	Stanwell	Vestas	22
10. King Island	HEC	Nordex	0.75
11. Thursday Island	Ergon	Vestas	0.45
12. Newcastle	Energy Australia	Vestas	0.66

Proposed	Owner	WTG Mfr	MW
1. Highroad	Stanwell	?	40
2. Dorrigo	Abigroup	?	300
3. Yass / Goulburn	Aust Power & Water	?	30
4. Wonthaggi / Cape Liptrap	Wind Power	?	100
5. Woolnorth Stage 1	Hydro Tasmania	Vestas	10.5
Stage 2	Hydro Tasmania	Vestas	200
6. Cape Bridgewater	Pacific Hydro	NEG Micon	60
7. Cape Nelson	Pacific Hydro	NEG Micon	59
8. Cape Sir William Grant	Pacific Hydro	NEG Micon	31.5
9. Ararat	Pacific Hydro	NEG Micon	75
10. Nirranda	Stanwell	?	30
11. Bridgewater Lakes	Windco	Enercon	30
12. Kongorong	Stanwell	?	30
13. Lake Bonney	Babcock Brown	Vestas	77
14. Woakwine	Beacon Energy	?	100
15. Starfish Hill	Tarong Energy	NEG Micon	30
16. Yabmana	Primergy & Wind	?	55
17. Tungketta Hill	Ausker / ANZ	NEG Micon	49.5
18. Nine Mile Beach	WPC	Enercon	3.6
19. Augusta	Stanwell	?	30 +
	Wind Power	?	100
20. Emu Downs	Stanwell	?	40
21. Joanna Plains	Stanwell	?	40
22. Geraldton / Mumbida	Windco	Enercon	30
23. Rottenest Island	R I Authority	?	0.6
24. Lord Howe Island	SEDA/LHI Board	?	0.3
25. Flinders Island	Hydro Tasmania	?	0.3
26. Thursday Island	Ergon	?	0.6
27. Yambak	Pacific Hydro	NEG Micon	30



Anchorage 2002

Current and Proposed Windfarms

- 2% New Renewable by 2010; + 3,800MW to be installed by 2010
- Wind seen as major contributor to achieve target (currently <100MW in windfarms installed)
- Long thin wire problem to connect windfarms (high transmission cost)
- Utilities and investors market not the "farmers"
- Long-term Power Purchase agreements required
- Difficult Approvals (NIMB, coastline, etc.)

Existing Wind/Diesel Systems

- Thursday Island – Operated by Ergon Energy
  450kW Wind, app 2,000kW max demand
- Denham – Operated by Western Power
  690kW Wind, 1,200kW max demand
- King Island – Operated by Hydro Tasmania
  750kW Wind, app 2,500kW max demand
- Esperance – Operated by Western Power
  2,000kW Wind, app 14,000kW max demand

Future Wind/Diesel in Australia

- Renewable Energy Diesel Rebate Scheme setup by Australian Greenhouse Office
- 50% of capital cost funded if offsetting diesel fuel
- Most diesel power stations in Central Australia with limited wind resource available
- Coastal regions with wind and diesel stations in cyclonic zones in northern Australia
- Small number of opportunities including the islands of the coast
- www.greenhouse.gov.au/renewable/rrpgp/index.html

Esperance Wind/Diesel – Wind/Gas

Esperance Project Objective

Phase I: Wind/Diesel (06/2003)

- Install new 6 x 600kW Windfarm
- Integrate existing 9 x 225kW Windfarm
- Maintain Minimum Diesel Loadings
- Maximise Fuel Savings

Phase II: Wind/Gas System (08/2004)

- Old Diesel Power Station Shutdown
- Interface to New Gas Turbine Power Station

Esperance Solution

Controllable WTG

3.6MW New Windfarm Enercon 6 x E40

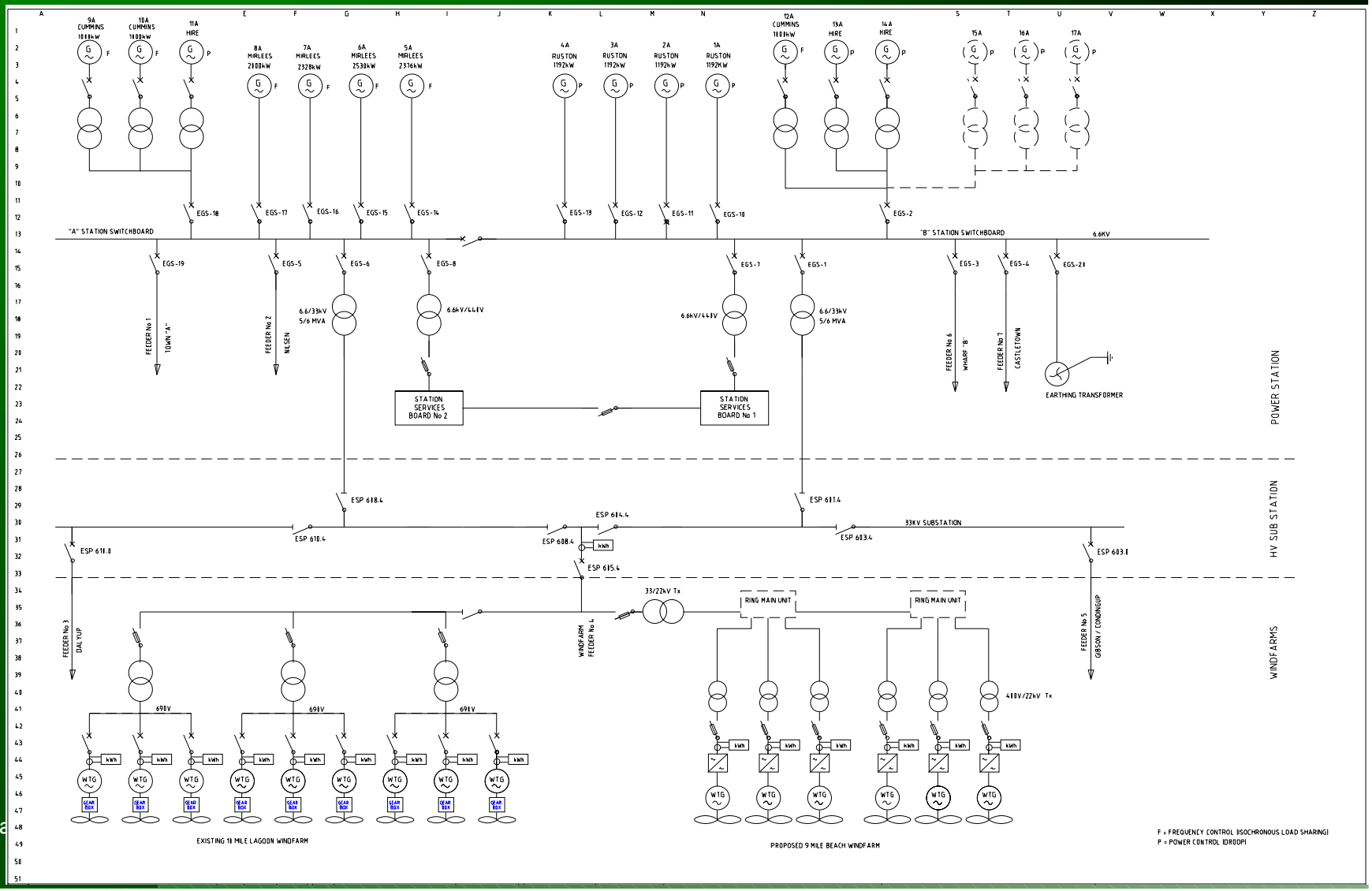
Controllable WTG

2MW Existing Windfarm Vestas 9 x V27

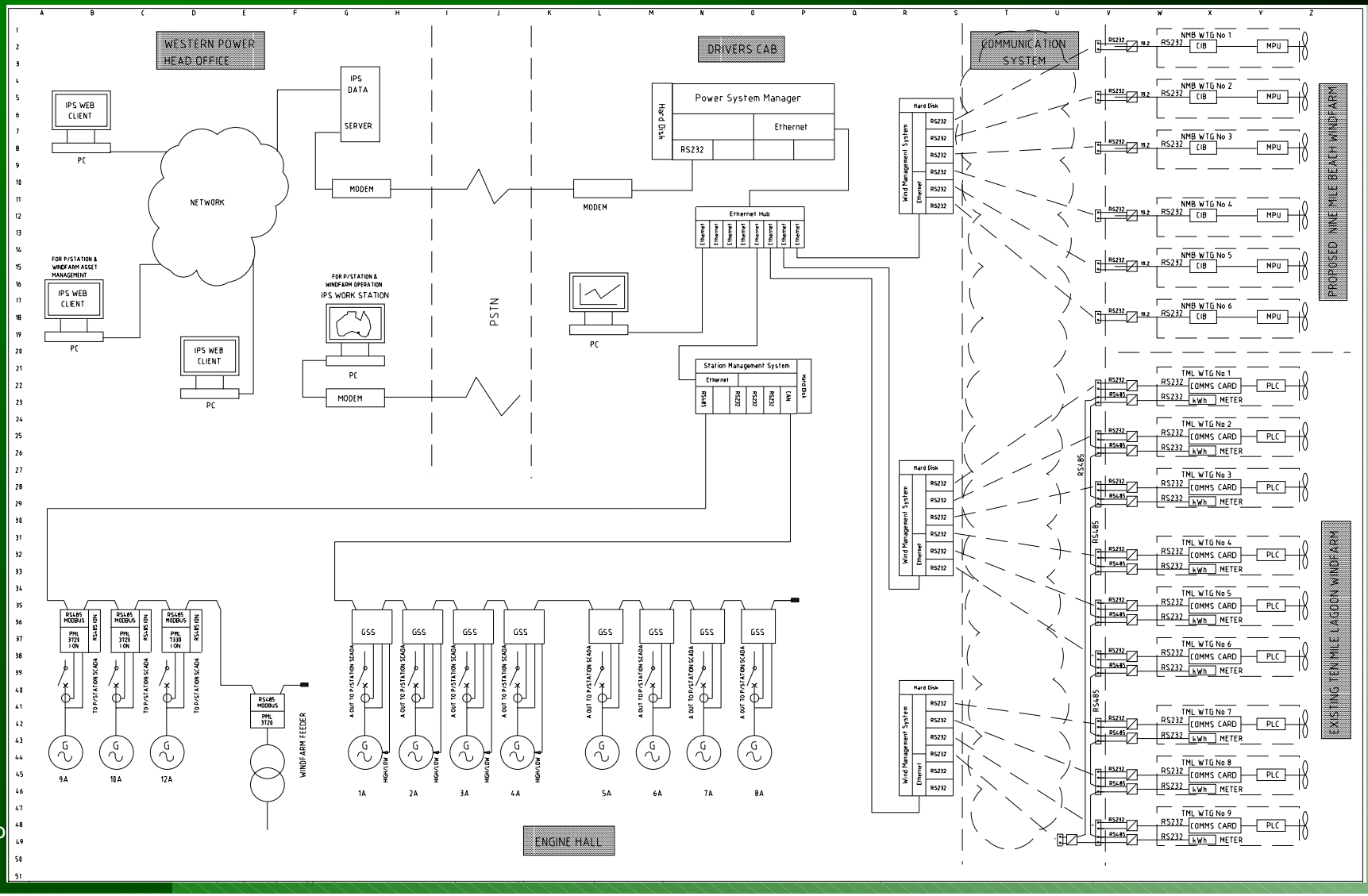
Central Station Automation

Intelligent Power System

Esperance Power System

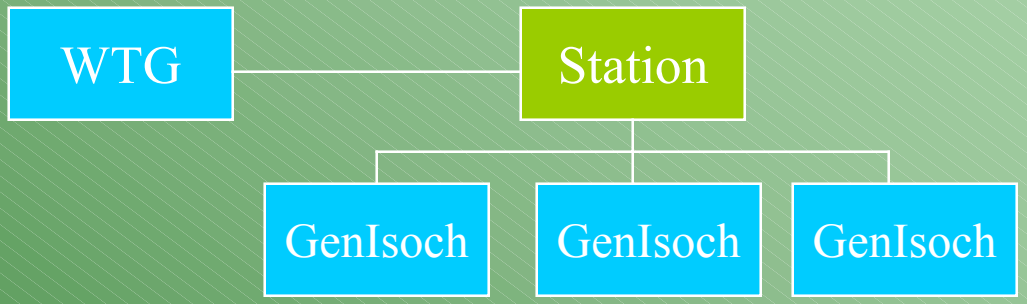


Esperance Control System

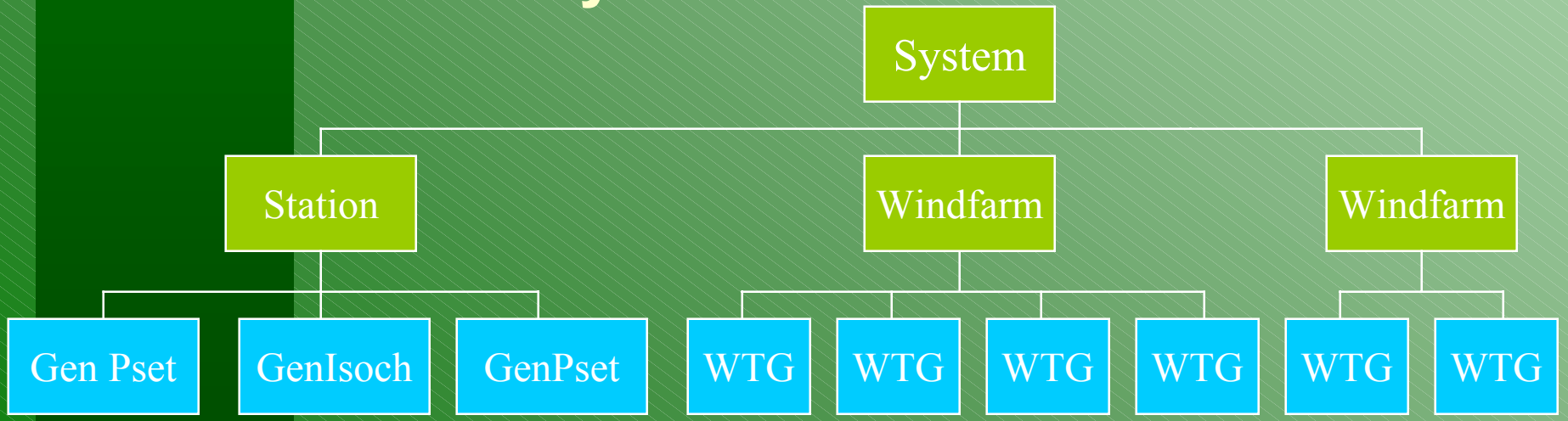


Outcomes Esperance Project

Central Station Control



Central Power System Control



IPS Wind/Diesel Mawson Antarctica

Images used by permission from AAD

Mawson Site Conditions

- Consistent wind speeds

  11.5 ms-1 annual mean

- Highest recorded wind gust 249 km/h

  (149mph)

- Lowest temperature –36degC (-33degF)

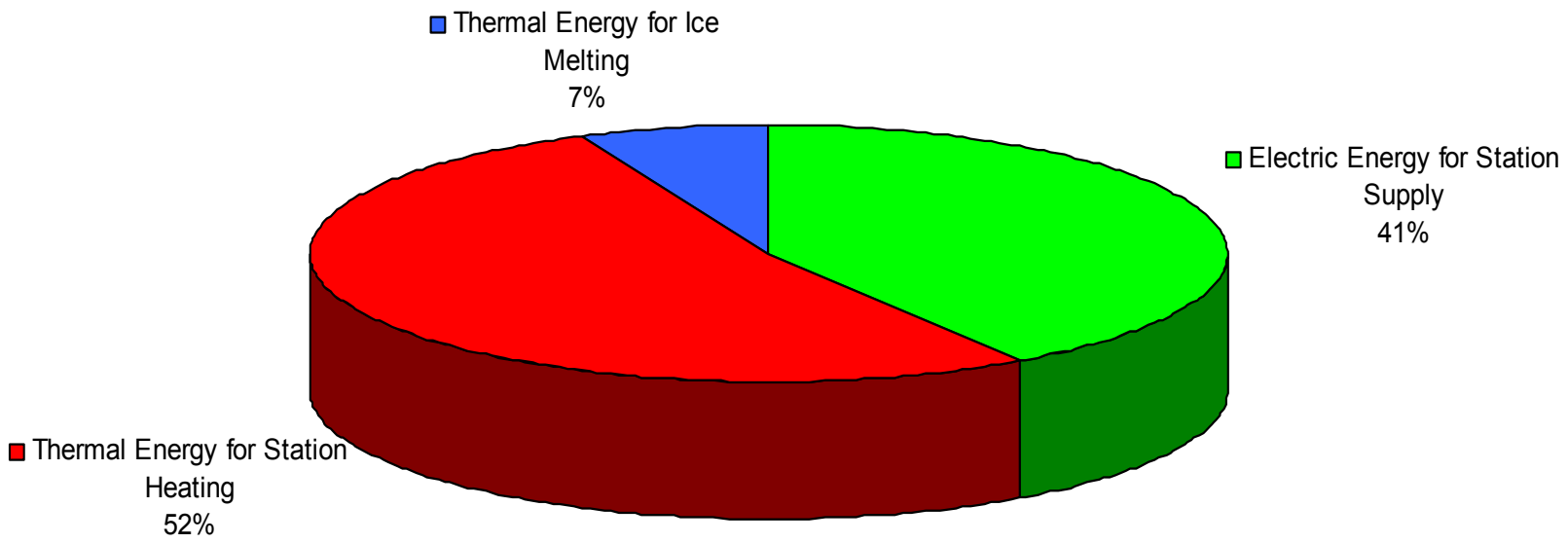
- Fine drift snow

Mawson Site Conditions

Mawson Existing Infrastructure

- Two diesel power stations
  - Main Power House: 4 x 125kW
  - Emergency Power House: 1 x 430kW
- Building Heating
  - Cogeneration diesel generator waste heat
  - Oil Heaters using diesel fuel
- Water making
  - Ice to water – 1,200 kl per annum

Mawson Energy Demand



Objectives of the Project

- Reduce diesel fuel usage by 66%
  - (from 750 to 255 kl/yr)
- Protect environment from fuel spills
- Reduced CO^2 emissions
- Maintain Quality of Supply
- Stagel Completion in 03/2003

Mawson Solution

Central Station Automation

Intelligent Power System

Controllable WTG

900kW Windfarm 3 x Cold Climate E30

Provision of Spinning Reserve

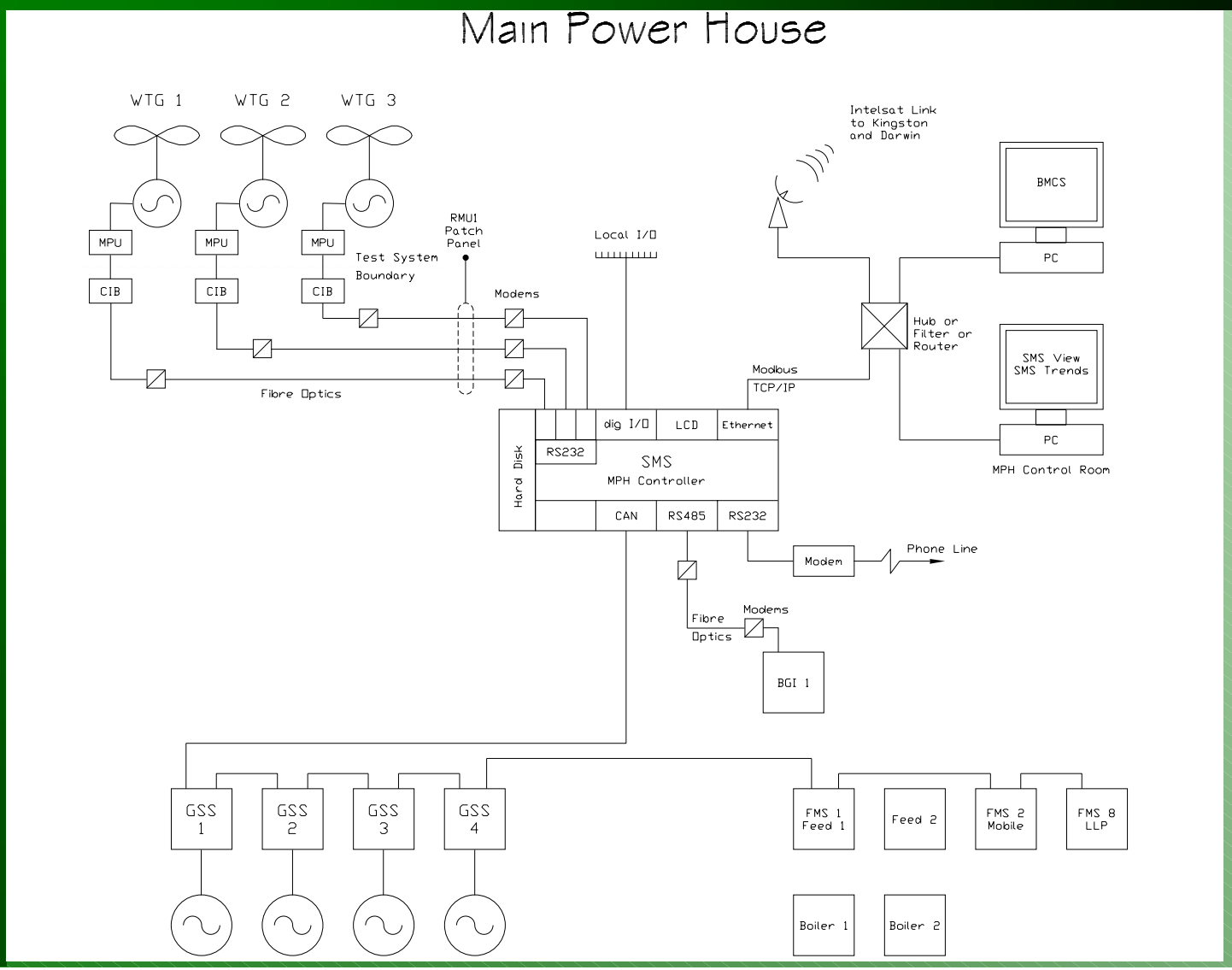
3 x 96kW DGI feeding Electric Boilers

Controllable Loads

Use of electrical boilers + building heating loop

Mawson Power Station

DMD
DGI
WTG
IPS



IPS Control & Distribution Board

Anchorage 2002

Mawson Engine Hall

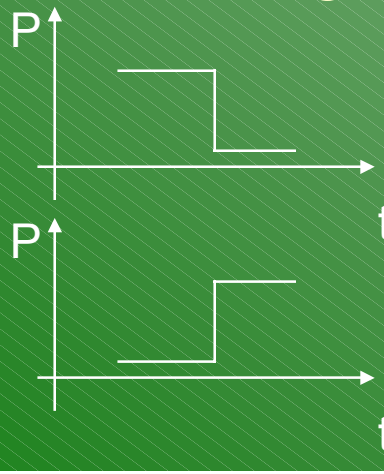
Anchorage 2002

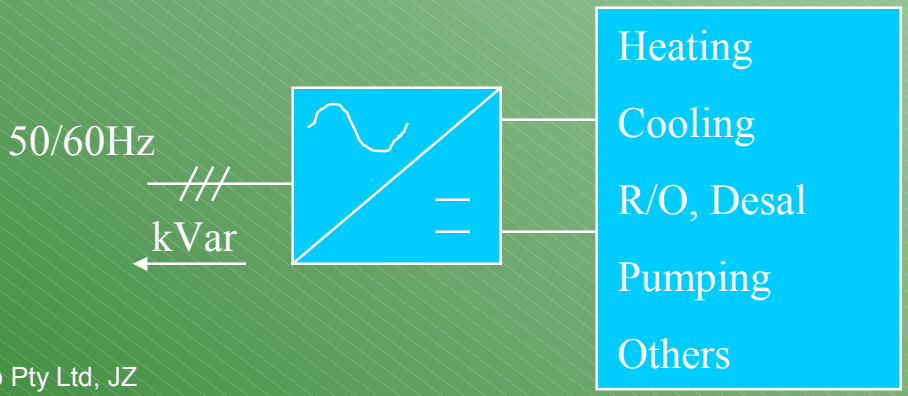
WTG 3 x E30 300kW

- 300kW
- Variable Speed Drive
- No gearbox
- Proven Enercon Concept
- Cold Climate Design
- Further info:
- mail@enercon.de

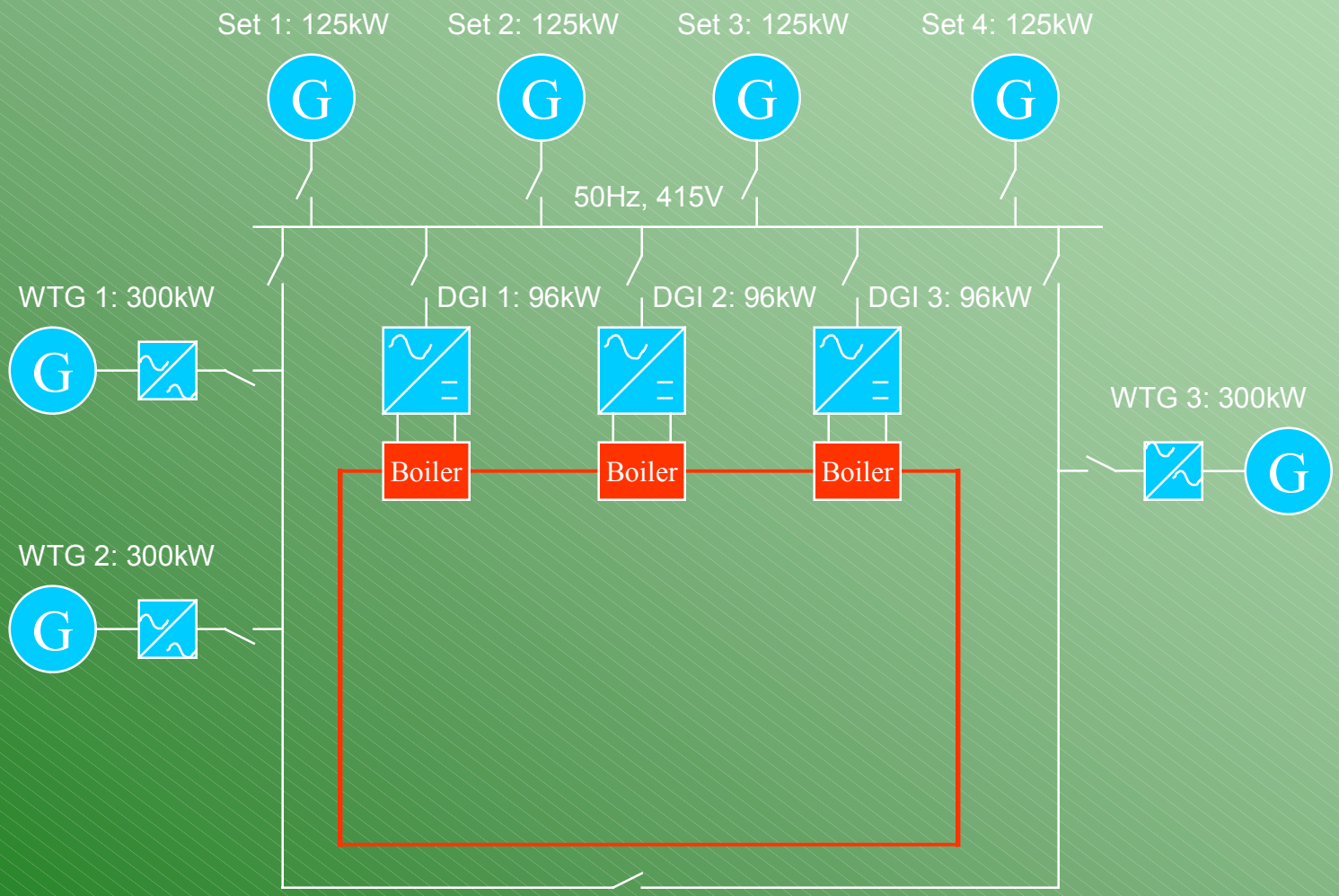
Dynamic Grid Interface

1. Power Electronics Solution converting electrical energy to e.g. heat energy
2. Different type of loads can be connected
3. Provides Spinning Reserve (-df/-dP)
4. Fast Energy Sink (df/dP)
5. Voltage Support (reactive power supply)





DGI at Mawson 3 x 96kW



96 kW Dynamic Grid Interface

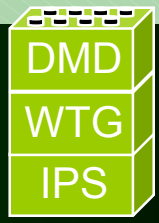
DGI Summary

- Modular Design (20kW to 600kW)
- Adaptable to AC or DC loads
- Control Modes
  - Soft Underfrequency / Undervoltage Control
  - Isochronous Frequency Control and Voltage Control with Diesel Generators
- Operation Modes
  - Standalone operation
  - IPS Integrated operation -> DMD

Result:

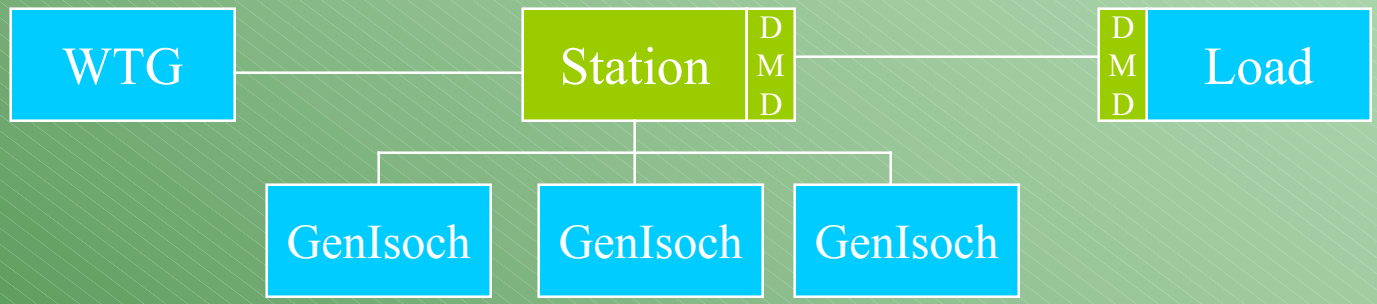
Less Diesel Sets online for Spinning Reserve

Demand Managed Device



- Typical Demand Managed Device:
  - Water Pumping into tank (multiple pumps on/off control)
- DMD Software Module in Station Controller:
  - Check tank water level, available wind and minimum pump runtimes to start/stop pumps
  - Loads are constantly bitting for minimum/essential demand and maximum/ideal demand
  - If Wind is available the maximum will be used if possible
  - If no wind is available the minimum will be supplied even if diesel power is required
- Outcome:
  - Higher Wind Penetration

DMD Without DGI

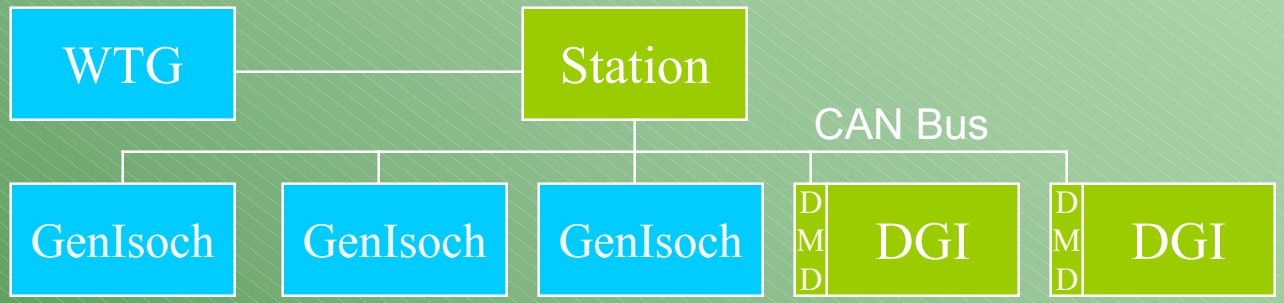


- Simple, Slow Control Interface
- Easy to retrofit

-> Increased Wind Penetration

-> No reduction of Spinning Reserve

DMD With DGI

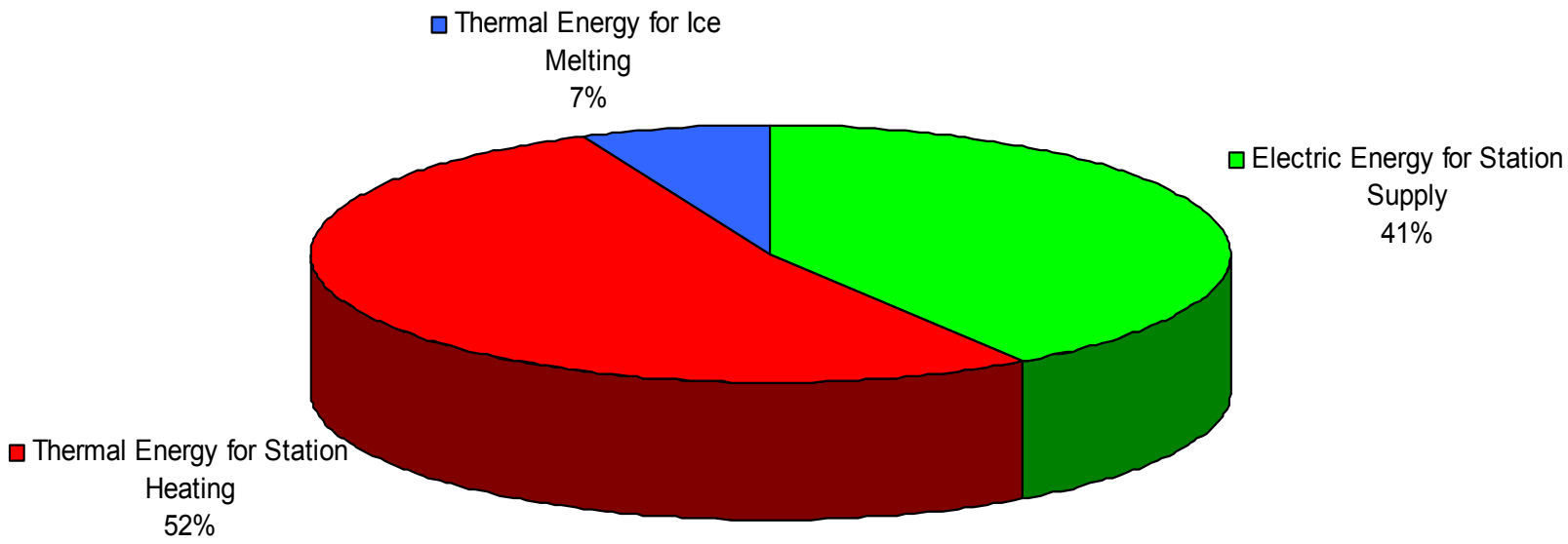


- Fast, Integrated Control Interface to Diesel Set
- No single point of failure

-> Increased Wind Penetration

-> Less Spinning Reserve carried by Diesel Set

Mawson Projected Outcomes



Mawson Projected Outcomes

- Full Automation of Mawson Power station
- Installation of three E30 Cold Climate WTG
- Average wind penetration of 66%
- Fuel Savings of 495,000 l/year
- Reduced number of voyages for fuel supply

Summary

Central Station Automation

Intelligent Power System

Controllable WTG

Power Output limit or Start/Stop

Provision of Spinning Reserve

Dynamic Grid Interface to connect variable loads to power system

Controllable Loads

Integration of Demand Managed Devices into IPS

Thank You

POWERCORP

Intelligent Power Systems

www.pcorp.com.au

Brochures

Denham Video CD

Live Dial-Up

Product Demonstration